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Squeezy Green Balls: Promoting Environmental Awareness through Playful Interactions

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ABSTRACT

We need collective action to tackle global warming. However, research shows that people switch off from being concerned about the environment because they are often too busy, or fail to appreciate their ability to make a difference. An alternative approach is to run campaigns that are able to engage large numbers of people and engender feelings of concern and empowerment. This could then kick-start a range of pro-environmental habits. We present the development and evaluation of a playful installation that aimed to attract attention, and stimulate discussion about environmental issues amongst university staff and students. The first prototype was shown to successfully attract people to engage and interact with the installation. The second prototype was deployed in-the-wild, over the course of a week. We evaluated the extent to which the installation was successful at attracting attention, and in encouraging people to interact with it, to reflect on their habits and to discuss environmental issues with others. We found the Green Ball Kiosk was a fun way to raise discussions about green issues, to encourage the adoption of new environmentally friendly behaviours and to prompt people to maintain existing ones. We suggest that interactive installations such as this can be effective at promoting awareness and generating a 'social buzz' about environmental topics when exhibited as a temporary installation.

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INTRODUCTION

Climate change is becoming an increasingly urgent issue with the Intergovernmental Panel on Climate Change calling for global actions to mitigate the problem [21]. Within the European Union, a target has been set to reduce greenhouse gases by at least 20% by 2020 [10] and it is clear that meeting this will require major changes across all levels of society. In the UK, it is estimated that lifestyle changes contribute up to a 30% reduction in greenhouse gases [41] but questions remain about how to effectively persuade people to change their environmentally related behaviours on a collective level.

Though individuals are increasingly aware of climate change, they do not necessarily view it as a priority [26; 30]. It has even been suggested that concern about the issue has actually been diminishing within the UK [31]. A study in the UK [27] suggests that degree-level educated people may be more willing to take environmentally-motivated principled actions (e.g. buy recycled paper products, avoid the purchase of over-packaged products), but are less willing than others to take relatively small actions that may be of a personal inconvenience (e.g. turn the TV off overnight, switch off lights in unused rooms).

What are effective methods that can be used at scale? Information campaigns have been criticized for being ineffective at leading to large scale change due to levels of apathy [33] and for making people feel helpless through relying on fear inducing content [32]. There is also a problem of information overload, as people are constantly bombarded with a variety of messages and advertisements. Similarly, in universities and other organisations, it is easy for an environmental poster to get lost among the many other posters on display.

Previous approaches by the HCI community to raise awareness of environmental issues have attempted to encourage individual behaviour change via interactive systems that track personal information [e.g. tracking household energy usage; 12; 24; 35; 38] and through mechanisms such as gamification [e.g. using competition as a way to reduce energy usage between households; 19; 13]. While these approaches may provide useful tools for those who already want to track and reduce their energy usage, they do not attempt to create initial engagement in, and reduce levels of apathy towards, environmental issues.

Brynjarsdóttir et al. [3] argue that another approach would be to design persuasive technologies that act as a catalyst for reflection on environmental issues. We suggest that the deployment of playful physical computing technologies [e.g. 15] might be a good candidate for this. By locating interactions in a public space, such interventions would be available to large numbers of people, and could be designed in a way as to prompt discussion on the wide range of sustainable actions that individuals can make within their day-to-day lives. In this paper we describe the development of a playful physical computing installation, the Green Ball Kiosk that was deployed in a university setting. We explore whether a playful technology could engage university students and staff to reflect on and re-engage with environmental issues that could lead them to taking small actions. We present the results of our evaluations of the intervention, discussing the extent to which it was successful at getting people to engage with the serious topic of climate change and environmentally friendly living.

RELATED WORK

Information campaigns

Froehlich [14] notes that one of the most widely used approaches to promote changes in environmental behaviours is to communicate information to the public through mediums such as leaflets, websites or social media. However, campaigns based on the "information deficit model" have been criticised as being ineffective for bringing about wide spread change due to the different ways in which problems can be framed, and for not considering the wider social contexts in which attitudes and behaviours are formed [33]. Framing is not just important in terms of whether actions are presented as avoiding loss or leading to a gain but also in terms of how relevant communication is on a personal level and the emotive quality of a message [39]. Fear appeals are particularly prevalent in climate change campaigns as a way of attracting attention to the issue [32]. However, fear can run the risk of desensitising individuals [32] or potentially lead to helplessness [25].

In the context of behaviour change, one strategy which may be particularly effective is to use "binding communication" which consists of pairing a persuasive message with a low-cost preparatory act [34]. Parant et al. [34] asked groups of participants to watch a climate change film about the effects of melting glaciers (the persuasive message) and found that those in the binding communication condition, who were asked to write down at least three actions they could take to reduce their carbon footprint, were much more likely to engage in behaviour follow-through than those in the control condition. They also suggest that binding communication with action helped to reduce the fear appeal of the film, resulting in a positive effect on attitude.

When it comes to raising awareness about climate change and promoting the adoption of sustainable behaviours, it is clear that how information is presented and interpreted is likely to impact on the success of the approach.

Tracking energy usage

In addition to attempting to change behaviours through providing information, technology can provide a more interactive way to engage people. Environmental sustainability has become an increasingly popular topic in HCI, where behaviour change interventions have ranged from embedding twinkly lights in the floor to lead people towards taking the stairs (as opposed to the lift) [36], to using ambient light displays to illustrate electricity usage in the work place [23]. The use of sensing and tracking technologies has been particularly prevalent [3], with a focus on developing systems that collect and visualise information e.g. about energy consumption [12; 24; 35; 38]. The aim of these systems is to deliver data in such a way that users become more aware of their activities and try to reduce their environmental impact [14].

For example, Costanza et al. [5] present FigureEnergy, an interactive visualization tool that allows users to annotate graphical representations in order to make sense of their own electricity consumption. However, research involving tracking systems often involves people who are already eco-friendly [14] and has been criticised for supporting a narrow set of prescribed behaviours, normally around reducing energy consumption [3].

Game based approaches

In an effort to motivate users, other tracking approaches have included game based elements. Froehlich [13] notes that commercial applications such as the Nest smart thermostat are implementing gamification techniques, e.g. awarding users with virtual leaves for setting energy efficient temperature levels. Video games have also been developed where sensor data is used as input to gameplay. For instance, Gustafsson et al. [19] present an energy conservation game for mobile phones that collects data

from an electric power meter in the home. The game involves missions and competition between households to encourage users to behave in particular ways (e.g. switching off lights, unplugging appliances when not in use). However, while the game was found to be engaging, the evaluation also indicated that players may have been more concerned about how to win than they were about energy conservation in the long term.

In addition, digital games have also been used to prompt reflection and discussion through delivering forms of "serious experience" that resonate with players [e.g. 20; 28]. With respect to the topic of climate change, games have focused on raising general awareness and educating players [e.g. 4, 6, 9, 11, 16]. For instance, Fate of the World [11] is a serious game, based on real climatic models, where the player has to set policy initiatives over a 200-year period and watch the social and environmental impact of their decisions play out. Another example is EnerCities [9], where players are challenged to develop an eco-friendly city while maintaining a budget and dealing with issues such as pollution and energy shortages.

However, with respect to serious games, debriefing (i.e. discussing gameplay content and the player experience) has been shown to be integral to a game's effectiveness [7; 8] but this is not usually supported outside formal educational contexts such as classrooms. Furthermore, many freely available online games focus on higher level issues (such as making policy and planning decisions) and have not been subject to a rigorous evaluation [22]. Thus it is unclear how far they engage people in reflecting on the issue of climate change or supporting individuals in considering direct ways to reduce their environmental impact.

Playful physical computing

Whilst each of the approaches described above aims to engage people in behaviour change, it is less clear how any of them might reach those who are apathetic about environmentally friendly behaviours. In order to increase the level of engagement with such issues we need to consider how to design interventions that can reach these people and that can encourage reflection and discussion around a wider range of environmentally friendly actions.

A promising method for engaging a diversity of people is through locating physical computing installations within public spaces. Through the 'honeypot effect', participants can be attracted by others who are interacting with a technology [2]. These approaches can be designed to be deliberately playful in order to stimulate curiosity and intrigue. For instance, the VoxBox [18] was designed as a playful physical questionnaire that comprises a range of physical input controls, such as sliders, dials, buttons, and spinners; real-time visualisations of collected data; and a tube which delivers a ball to the users when they have completed the survey. The installation has been used to gather opinions from members of the public at a number of events such as the Tour de France in London, and has been shown to incentivise participation through the range of playful and tangible interactions it offers [18]. A similar system, Sens-Us [17] has also been used in a quite different context, to gather data for the UK census (which can include questions about more sensitive topics).

Physical computing technologies have also been used to deliver playful interactions within the workplace. Gallacher et al. [15] developed the Mood Squeezer, consisting of a squeeze kiosk of differently coloured balls, which invites users to squeeze according to their mood. Through creating opportunities for people to socialise, the intervention was able to create a more positive and open work environment, providing employees with opportunities for self-reflection and to engage in conversation with others.

These examples indicate the potential of using tangible systems for attracting attention and encouraging discussion through locating playful interventions in public work spaces. In the following sections, we describe how we adapted an existing intervention and deployed it in order to attract the attention of students and staff, to get people talking about environmental issues and encourage them to reflect on their own behaviours.

OUR STUDY

In this paper we describe the development of a physical computing installation. We include a description of the interactive element – prototype #1, the Green SqueezeBox; the evaluation of this intervention at two events in order to determine whether it is effective at attracting the attention of attendees; the further development of the installation to create prototype #2, the Green Ball Kiosk; and the in-the-wild evaluation of this installation when it was deployed in a university setting for a week.

PROTOTYPE #1: DESIGN OF THE GREEN SQUEEZE BOX

Given the success of the Mood Squeezer study [15], we decided to adapt the original design by changing the colours of the six balls to different shades of green, varying from light to dark (see Figure 1).

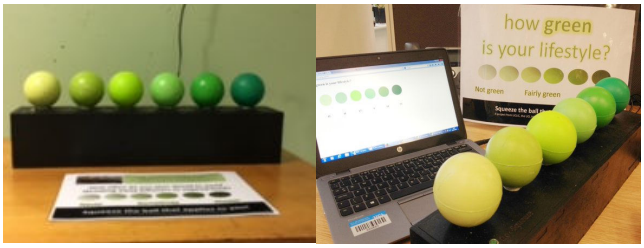

Figure 1. Images of the input and output devices; Green SqueezeBox and a laptop showing the webpage

The Green SqueezeBox used Force Sensitive Resistors (FSRs) in each ball to detect squeezes, which were monitored and transmitted to a backend server by an Ardunio Uno (an electronics prototyping platform). Squeeze data was processed and logged by the backend

server and relayed in real time to a web-page. See Figure 2 for an example of the webpage output.

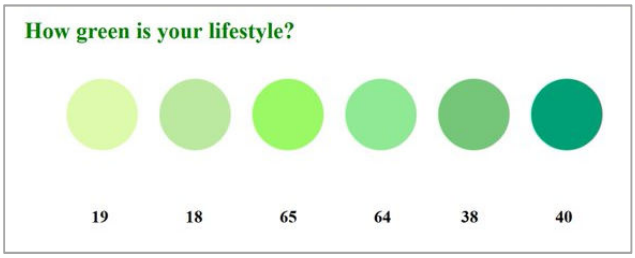

Figure 2. Green SqueezeBox webpage, showing the number of squeezes for each ball

EVALUATING THE GREEN SQUEEZE BOX AT EVENTS

We evaluated the Green SqueezeBox at two events: 1) a Welcome Fair targeted at new university students, and 2) a Professional Services Conference targeted at university staff.

The UCL Welcome Fair is a two-day event that took place on Saturday 3rd October and Sunday 4th October 2015. Over 250 clubs and societies booked stalls so that they could get an opportunity to interact with university students and distribute promotional materials. It is one of the UK's biggest welcome fairs. The Green SqueezeBox was utilized as part of the UCL Green Stand.

The UCL Professional Services Conference is a one-day event that took place on Tuesday 2nd February 2016. The conference celebrates the achievements of university staff across departments. It provides an opportunity for hundreds of colleagues to come together to hear about exciting collaborative and cross-faculty projects. During the one-hour lunch break, conference attendees were invited to visit various stands in the "Market Place" and to network with others. The Green Squeezebox was utilized as part of the UCL Psychology and Language Sciences (PALS) stand.

At both events, the goal was to attract interest to the stand, by providing something physical that visitors would want to interact with. The staff running the stand asked visitors to squeeze the balls in response to the question "How green is your lifestyle?" The question was deliberately opened-ended to encourage conversations between the staff running the stand and those attending the events. The six green balls represented a Likert scale response, varying from "not green" (left balls) to "fairly green" (middle balls) to "very green" (right balls).

Results: On Day 1 of the Welcome Fair, 168 squeezes were recorded and on Day 2, 77 squeezes were recorded (see Table 1). The middle balls (representing "fairly green") were squeezed the most often; in particular, the 4th green ball was squeezed by 33.3% of visitors on Day 1 and 33.8% visitors on Day 2. For the Professional Services Conference, 25 squeezes were recorded. The middle balls (representing "fairly green") were squeezed the most often; in particular, the 3rd green ball was squeezed by 40% of visitors.

In a follow-up interview, the staff member running the Welcome Fair stand said that he found the Green Squeezebox to be a good way of attracting students and it was different to the typical approach of just handing out leaflets. He described how some students approached to ask "what is that?" and how others were intrigued by seeing them squeeze one of the balls. He was then able to lever this initial interest to engage them in a casual conversation about green issues. For example, some students talked about how they used to be greener before they came to London. For many it was their first time living away from home, buying things for themselves. They talked about food choices, e.g. buying cheaper products rather than buying free-range. They also talked about travel choices and pollution. Many viewed themselves as in the middle – they were a bit "green", but they could do better.

	Not green		Fairly green		Very green	
WF 1	**10**	**7**	**51**	**56**	**28**	**16**
N=168	*6%*	*4.2%*	*30.4%*	*33.3%*	*16.7%*	*9.5%*
WF 2	**6**	**10**	**16**	**26**	**14**	**5**
N=77	*7.8%*	*13%*	*20.8%*	*33.8%*	*18.2%*	*6.5%*
PSC	**0**	**1**	**10**	**7**	**5**	**2**
N=25	*0%*	*4%*	*40%*	*28%*	*20%*	*8%*

Table 1. Squeeze data for the Welcome Fair (WF) and the Professional Services Conference (PSC). Red font indicates modal response.

The person running the PALS stand at the Professional Services Conference agreed that the Green SqueezeBox was a good way of attracting visitors to the stand. He described how he was able to make jokes with visitors, asking them "Do you want to squeeze my balls?" This helped to lighten the mood and get visitors to open up about what being green means to them, and the things they do (and don't do) that were green. For example, staff talked about green issues such as recycling, switching off lights, wearing a jumper instead of turning up the heating, shopping for organic food, cycling/walking to work. Some staff felt that they still used too much paper in their office and more effort was needed before they were truly "paperless". Packaging waste was another concern.

Overall, our study of the Green Squeezebox in the different university settings indicates it was effective as a novel way of attracting students and staff, and prompting conversations about green issues. The use of the different shades of green to represent a Likert scale response was understood by visitors and did not require further explanation. Next we decided to explore how the Green Squeezebox could be utilized as a stand-alone installation, as part of a study exploring the effectiveness of different environmental messages.

PROTOTYPE #2: DESIGN OF THE GREEN BALL KIOSK

In the Green Ball Kiosk we combined the Green Squeezebox with different environmental messages. Our goal was to create an engaging installation that would attract passers-by and encourage discussion about green issues without being co-located with a manned stall [similar to 15].

As this was to act as a stand-alone intervention, we decided to combine the Kiosk with a TV screen and handout which suggested different actions for mitigating climate change. These actions were combined in a persuasive message [33] which framed information in a negative, neutral or positive way. In line with previous literature [37, 39, 40], we chose images and messages that would be relevant to our participants (staff and students living in London, UK). See Table 2 for the five messages and related questions. The six green balls represented a Likert scale response, varying from "never" (left balls) to "sometimes" (middle balls) to "always" (right balls).

Day	Message	Question
1	Producing, harvesting, transporting, and packaging food produces tons of carbon dioxide... One thing you can do to save energy and mitigate climate change is to avoid wasting food.	How often do you plan ahead to avoid throwing away leftovers or expired food?
2	Big Ben could be underwater by 2100… One thing you can do to save energy and mitigate climate change is to put a layer on, not the heating.	How often do you put another layer on when it gets colder, instead of putting on the heating?
3	Spend more time watching Netflix and less time cooking in the kitchen… One thing you can do to save energy and mitigate climate change is to put a lid on your pots.	How often do you put a lid on your pots when you are cooking?
4	As early as 2030, mosquitoes could bring deadly tropical diseases to the UK… One thing you can do to save energy and mitigate climate change is to take the stairs, not the lift.	How often do you choose to take the stairs, not the lift?
5	Increase your chances for romance… One thing you can do to save energy and mitigate climate change is to switch off lights and appliances.	How often do you switch off lights and appliances that you don't need?

Table 2. Green Ball Kiosk messages and questions

Message 1 (with a picture of trucks transporting food) was designed to be neutral. Messages 2 (with an image of Big Ben going underwater) and 4 (with an image of a mosquito) were designed to be negative and uncomfortable. Messages 3 (with a picture a living room with Netflix on TV) and 5 (with a photo of a candle lit dinner) were designed to be more positive and playful. In line with research on "serious experience" [20; 29] and climate change communication [32] we predicted that negative messages would be more memorable than positive ones. The messages were piloted with 19 participants to ensure the emotive tone was in line with the way they had been framed.

In contrast to our previous use of the Green Squeezebox at events, we did not share the live webpage alongside the Green Ball Kiosk. The main reason for this was practical: in our study we planned to use a large LCD screen to show the message and question for the day as part of a PowerPoint slideshow, and we were unable to include a webpage as part of this slideshow.

RESEARCH QUESTIONS

We aimed to answer five research questions:

1. How does interaction with the Green Ball Kiosk vary over the course of five days?
2. Does the positive/negative phrasing of a message affect how memorable it is?
3. What factors motivate people to interact with the Green Ball Kiosk?
4. Is the Green Ball Kiosk successful in encouraging environmental discussions?
5. Does interacting with the Green Ball Kiosk lead to attitude/behaviour change?

METHODOLOGY

The Green Ball Kiosk was set up outside of the UCL Psychology common room (see Figure 2) for five consecutive days in early 2016. It was a typical week of the year, where staff are in offices and students attend lectures. We chose to set up the Kiosk outside of the common room because it is a social hub used by Psychology students and staff alike, and we wanted a location where people would naturally chat to others and be sociable.

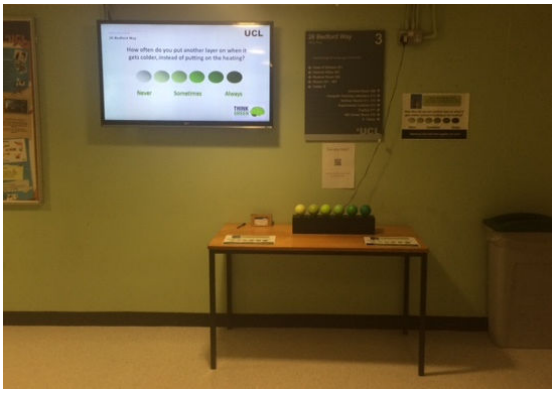

Figure 2. Green Ball Kiosk setup

On each day, a new environmental message was displayed, followed by a question was presented on the LCD screen which invited passers-by to squeeze a ball in response. Several nearby posters repeated the information displayed on the LCD screen. The posters also displayed a QR code and a web link, allowing visitors to find out more information presented in the messages if they wished.

An email was sent to all staff and students on the first day of the installation, informing them about the arrival of the Green Ball Kiosk, that it would be present for one week only, and that messages and questions would change each day. No further emails were sent that week.

The following week, an online survey was sent to all staff and students. The survey consisted of 13 questions asking respondents about their interactions with the Kiosk, whether they could recall any of the messages and/or questions, and whether they would be willing to take part in follow-up interviews. To incentivize participation, we announced that 2 survey participants and 2 interview participants would be selected at random to receive £10 gift vouchers.

We collected 41 survey responses. Regarding occupation, 35 (85%) were students (24 undergraduates, 4 postgraduates, 7 doctoral) and 6 (15%) were staff (5 support staff, 1 'other'). Regarding gender, 28 were female (68%) and 13 were male (32%). Their ages ranged from 18 to 53 years, mean age = 24.5 years (SD = 8.5).

Out of the 41 survey respondents, 15 (37%) agreed to take part in follow-up interviews. Regarding occupation, 12 were students and 3 were staff. Regarding gender, 11 were female and 4 were male. Their ages ranged from 19 to 53 years, mean age = 24.5 years (SD = 10.3).

The interviews were exploratory and semi-structured, though a script was used to ensure consistency between the three researchers who carried out the interviews. Each interview was audio recorded and lasted approximately 15 minutes. The resulting transcripts were coded and analysed using thematic analysis [1].

RESULTS

Below we present our results structured around our 5 research questions.

1. How does interaction with the Green Ball Kiosk vary over the course of five days?

Table 3 shows squeeze data for each day. The most active day was Monday (241 squeezes). The number of squeezes declines for subsequent days, Wednesday and Friday recording half as many squeezes (125 and 120 respectively). The data is generally skewed towards positive answers (i.e. "sometimes" or "always").

Analysis of the time of day for squeezes reveals that the frequency of squeezes is normally distributed, centering around lunchtime (13:00 to 14:00). There is a second peak around 16:00, possibly indicating a popular time that staff and students take a coffee break.

	Never		Sometimes		Always	
Day 1	**29**	**18**	**27**	**52**	**64**	**51**
N=241	*12%*	*7.5*	*11.2*	*21.6*	*26.6*	*21.2*
Day 2	**23**	**9**	**17**	**29**	**39**	**40**
N=157	*14.6%*	*5.7*	*10.8*	*18.5*	*24.8*	*25.5*
Day 3	**12**	**22**	**28**	**33**	**11**	**19**
N=125	*9.6%*	*17.6*	*22.4*	*26.4*	*8.8*	*15.2*
Day 4	**18**	**19**	**43**	**45**	**35**	**20**
N=180	*10%*	*10.6*	*23.9*	*25*	*19.4*	*11.1*
Day 5	**12**	**9**	**16**	**17**	**46**	**20**
N=120	*10%*	*7.5*	*13.3*	*14.2*	*38.3*	*16.7*

Table 3. Squeeze Data for the Green Ball Kiosk. Red font indicates modal response.

Survey Data

Survey respondents were asked to recall which days they saw the Green Ball Kiosk and which days they squeezed one (or more) of the balls. Generally, when they saw the Green Ball Kiosk they also squeezed one or more of the balls; see Figure 3. On average, they interacted with the Kiosk for 2 days out of the 5. Only 9 survey respondents (22%) saw the Kiosk on all 5 days, and only 3 respondents (7.3%) squeezed one (or more) of the balls on all 5 days.

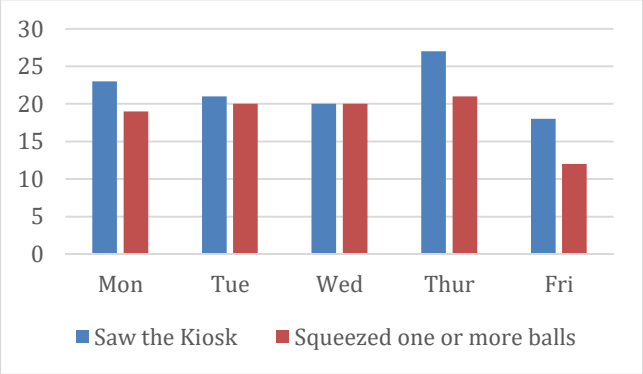

Figure 3. Number of survey respondents that saw the Green Ball Kiosk each day and squeezed one or more balls

Survey respondents were also asked about the QR code and web link provided on the poster. Only 18 respondents (44%) answered 'yes' that they noticed these links, and only 1 person answered 'yes' that they used it to find more information about the topic. The majority of participants (39 out of 41; 95%) answered 'no' that they did not check the link; 1 participant answered 'not sure'.

2. Does the positive/negative phrasing of a message affect how memorable it is?

Survey respondents were asked to recall as much as possible about the Green Kiosk messages. We tallied the

number of respondents who recalled the message for each day, then considering the number of respondents that had seen the message that day we calculated percentages. On average, 49% of respondents who saw the Kiosk on any given day were able to recall the message. As can be seen in Figure 4, uncomfortable messages (Tuesday 48%, Thursday 44%) and comfortable messages (Wednesday 55%, Friday 50%) were recalled at roughly the same rate.

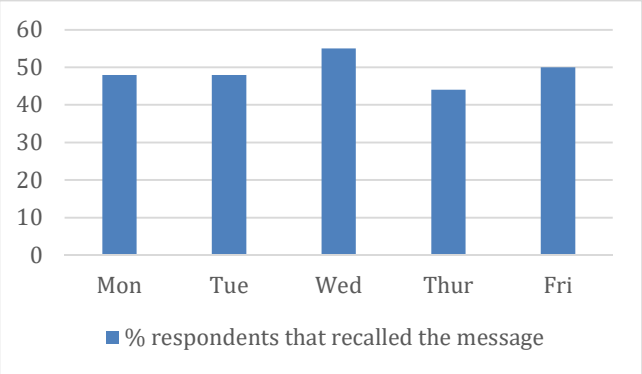

Figure 4. Percentage of survey respondents that recalled the Green Ball Kiosk message each day

In our follow-up interviews, participants suggested possible reasons for why they remembered some messages but not others. One theme was ***personal relevance*** (n=6). P1 said *"The lift one made me a bit uncomfortable as I'd literally just got out of the lift"*. Similarly, P8 said *"I think some of the questions were more personal to me like the one about taking the stairs rather than the lift"*. P2 remembered turning off electrical appliances and lights, using the stairs instead of the lift: *"probably because these are things I do"*.

Another theme was ***learning new information*** (n=3). P6 remembered putting lids on pans: *"I thought it was interesting because although I don't regularly cook I would never think to put a cover over the pan to conserve heat"*. P5 remembered wearing a jumper instead of turning the heating up: *"...realizing that I put the heating on for the whole day, and it's not really good for the environment"*. Conversely, P4 suggested that the messages weren't memorable because *"it wasn't new information, I wasn't learning anything, just reinforcing what I knew."*

Emotional reactions were mentioned only in relation to uncomfortable messages (n=2). P8 said *"There was one with the Big Ben underwater [...] I remember thinking oh that's a bit depressing"*. Similarly, P15 said *"some of the messages were quite shocking like the flooding one. I thought it was quite strange because on the outlook it looks like a really fun experiment that's going to make me feel happy but then it's actually just a bit scary and depressing."*

There was also a tendency to recall the ***questions*** rather than the full message. One possible explanation is that interactions with the Green Ball Kiosk were short, so people focused more on the information they needed to respond to. P4 explains *"I read questions quite quickly, I wouldn't actually stay there to think about it at all"*. ***Font size*** could be another factor. P5 said *"I know I saw the question because it was in a big font, and it was quite eye-catchy. I'm not sure how big the messages were..."* Similarly, P2 said *"I think the message could have been bigger and more obvious, maybe like in big writing on the wall behind the Kiosk, because clearly it didn't grab enough of my attention!"*

Additionally, five participants recalled a question that wasn't present in the Green Ball Kiosk: *"I'm assuming that there was something about cycling... probably recycling too"* (P15); *"Bottled water... if you use the reusable plastic container for water. Oh, it wasn't there?"* (P3).

3. What factors motivate people to interact with the Green Ball Kiosk?

In our follow-up interviews, participants discussed how they felt motivated to interact with the Green Ball Kiosk for multiple reasons. They also explained why they did not interact with the installation on some days.

Novelty and fun

Nine participants mentioned that they were first drawn to interact with the installation because it was novel, fun and made them curious: *"I was curious, it seemed like a fun thing to do"* (P13); *"I thought it looked different and I was like ooh intrigued"* (P7); *"I thought it looked very appealing, they're like squidgy"* (P15). Interactivity was an important aspect: *"it wasn't something that people saw every day, so they noticed something that was interactive"* (P3); *"it seems a lot more interactive and engaging than other things like that I've seen"* (P15). Two participants also mentioned that they liked the playful innuendo around being invited to 'squeeze balls': *"I thought the name was quite funny and it did make me and my friends laugh!"* (P12).

However, some participants (n=3) questioned how long this novelty effect would last: *"I think five days was enough, if it was longer, people might get bored and irritated by it, like they might see it as something negative or even just feel lazy"* (P2); *"I expect you would see use of it to drop off as time goes on, I don't think it would work as a permanent installation"* (P1). Similarly, P12 said that she became less interested over time: *"Because it was not new, I knew what it was about, no curiosity anymore"*.

Helping research

Seven participants said that they took part because they wanted to help with research. Some felt that they were helping environmental research, while others were more concerned with helping colleagues in their department: *"it's good to help with any research that might improve environment stuff"* (P1); *"I knew it was an experiment and I could help people with the data collection"* (P5).

Convenience

Participants liked that it was quick and convenient to take part (n=8): *"short and sweet*" (P9); *"it was cool, just a novelty thing that didn't take too much time and effort"* (P1); "*I liked that it was easy, convenient and very well placed, so people could casually wander off and it's a good way of getting people to think about their behaviour"* (P11). Two participants described getting into the habit of squeezing as they walked past: *"Became slightly habitual - like come out of the lift, squeeze the ball, get a coffee in the common room"* (P1); *"Each day I had in the back of my mind that I should do it. And well also it's in between my office and the toilet, so I sort of had to pass by it every day"* (P4).

Despite it being quick to engage with, a common reason that participants gave for not interacting with the Green Ball Kiosk was lack of time (n=5): *"I think I was in a rush one day"* (P5); *"Probably because that time I was rushing for a class"* (P10); *"I'd be running into the cafe for lunch break before I had a double lecture"* (P14). Also two participants said they did not pass by the Green Ball Kiosk on some days: *"because I did not go to the cafe, and I had other things to do on different floors"* (P11); *"Well I was not in the building the other times"* (P13).

Honey-pot effect

One participant described how she became intrigued when she saw another person interacting with the Green Ball Kiosk: *"I saw [name] squeeze one of the green balls and I thought oh that looks really interesting so I squeezed one and encouraged my friend to do the same so we could compare our results"* (P6). Another participant described how there was a 'buzz' of activity round the installation: *"I definitely saw a lot of people buzzing around it especially in the first couple of days. People generally looked quite curious and giggly about squeezing the balls"* (P1).

Two participants described visiting the Kiosk as part of a group: *"my group of friends was expecting the balls to be there so once they were there it was definitely a feeling of excitement"* (P9); *"there were several of us and we stood in front of it trying to figure out what it is"* (P12). On the other hand, sometimes group dynamics discouraged interaction: *"it was quite crowded at certain points of the day and it made it quite difficult to approach it"* (P15).

4. Is the Green Ball Kiosk successful in encouraging environmental discussions?

20 out of 41 survey respondents (48.8%) answered 'yes' that they spoke to others about their experience with the Green Ball Kiosk. In our follow-up interviews, we were able to find out more about the conversations that people had. P10 told her friends about it in case they were interested in taking part: *"I just said something like the Kiosk is very interesting, it will be there for a week so maybe if you're free you can pop by and have a go".*

Other conversations focused more on the environment. P2 said that she talked about the message she had read about that day: *"we were talking about how we cooked over the weekend so we wouldn't be cooking for these days now".* P13 said that she talked about that day's Kiosk message and also other pro-environmental actions that she knew of: *"I did have a conversation later about taking the stairs if it's only going up or down one floor. Also using ceramic mugs instead of Styrofoam plastic cups, things like printer control measures for people that use too much paper".*

P9 describes how her experience with the Kiosk prompted her to engage her flat mate in a conversation they had had previously, but this time she was more opening to listening to her flat mate's advice: *"I did discuss one which was about food wastage with my flat mate who always tried to make me reduce the amount of food I waste, and the fact that it came from my university and not one of the people I live with sort of made the message even stronger".*

Four of our interview participants said that they did not talk about the installation with others. P2 explains that she did not think about it much afterwards: *"I didn't discuss it and [the messages] haven't really been on my mind, no."* P14 thought that her friends would not find environmental discussions interesting: *"that would have been a really boring conversation".*

5. Does interacting with the Green Ball Kiosk lead to attitude/behaviour change?

Out of the 41 survey respondents, 18 (43.9%) answered 'yes' that their attitudes had been influenced because of the Kiosk, and 28 (68.3%) answered 'yes' that they had changed their behaviours due to the Kiosk. In our follow-up interviews, we were able to find out more about the changes that participants experienced, and factors that motivated these changes.

Reflection

The Green Ball Kiosk encouraged participants to reflect on their habits and whether they align with their values. Two participants described squeezing a light green ball (i.e. "never") and feeling like they could be doing more: *"I squeezed the ball and I was thinking it shouldn't be the one that I'm squeezing so it did make me think I should be doing better for the environment"* (P7); *"I didn't like it because I couldn't press one of the darker balls, so I try to use the stairs more. But only going down the stairs. Still too lazy to use them going up!"* (P2)

Similarly, three participants describe changing their behaviour after reading one of the messages: *"I've recently adjusted the heating based on the temperature. I was like oh I am cold now, I could do the jacket, instead of increasing the heating"* (P5); *"some of the questions were more personal to me, like the one about taking the stairs rather than the lift, I do actually take the stairs more now, it's had a bit of an impact"* (P8); *"it's actually stayed in my mind, I actually took the stairs" (P10).*

New knowledge

One participant describes how he learned something new from the Kiosk: *"I'm sure now if I see my flat mates*

cooking I'll bring up that point to them because I didn't realise you know how much impact just a little cover on your pan can have so I guess it has impacted my knowledge about pro-environmental behaviour somewhat" (P6).

Good reminder

For other participants, the Green Ball Kiosk served as a useful reminder of pro-environmental behaviours they already wanted to engage in. P1 describes how it reminded him to take the stairs: "*They did remind me to take the stairs down rather than the lift! You kind of just go on autopilot and before you know it you're in a lift going down […] that statement kind of reminded me to turn off that autopilot."*

Four participants said that were already engaged in these pro-environmental behaviours, but they still felt that it was good to get a reminder: *"I didn't change my behaviour probably because I'm already doing those things. But it reminded me of the things, so I think that was good"* (P3); *"I haven't really changed my behaviour really, no. But maybe made me aware and made me think more about it."* (P4); *"I already took reasonable actions for those such as turning the lights off […] I sort of do that thing generally but yeah it's nice as a little reminder"* (P8); *"I guess it just reminded me of the need to be environmentally friendly"* (P13).

The Kiosk also served as a reminder of environmental issues in general. P15 recalls a message that wasn't present (recycling) and that she's thinking about volunteering for charity work: *"There was one message I think about recycling […] I was thinking of volunteering for a good cause and I guess it got me thinking that I could volunteer for an environmental charity"* (P15).

No change

Several participants (n=5) stated that the Green Ball Kiosk made no difference to their behaviour because they were already 'green'. P15 said *"I was already aware of the environmental issues, so it just reinforced my beliefs rather than changed them."* In addition, there appeared to be a risk of 'green information overload'. P14 said *"I've always been an environmentally friendly person anyway so squeezing a ball to say that I know about recycling didn't necessarily change anything […] the media and everything bombards you of images of like, polar bears falling off icebergs and people telling you to turn your lights off and, you know, the Kiosk didn't really offer anything that I haven't really heard or seen before. I mean every time I leave a room I think, 'oh I better turn that light off' but that's just me being habitual rather than me being reminded of squeezing the ball".*

Another issue was that participants did not remember all of the messages: *"Though in the moment I did pay attention to them, they didn't stick with me"* (P1); *"it was like a whole week ago, it's not really fresh in my mind anymore"* (P2). P11 viewed the Kiosk as just a 'mild distraction': *"I think all of them made me think about things I wouldn't normally think about at that particular time of day, but not in a way that would make me want to change my behaviour, just more that I hadn't evaluated those things before […] if anything I think it was an extremely mild and possibly pleasant distraction, it was something to think about whilst I came out of the lift".*

Suggested Improvements

Participants made several suggestions for improvements and further developments to the installation. Seven participants mentioned that they would like to receive feedback when they squeezed the ball. P3 suggests *"when people answer question it would give you some results and statistics, you responded like 83% of your peers and stuff like that. And that's also a very important thing, because I think there are studies showing that if you are convinced that other people do something you are more likely to do it, because of social pressure."* A few participants said that competition between people, or even buildings, would support their willingness to be 'greener' and engage in environmentally friendly behaviour.

Three participants suggested the need for various events and talks to make people discuss environmentally friendly issues. They did not feel that the Kiosk encouraged them to discuss the messages and felt that the experience could be improved by having the Kiosk be manned: *"someone could stay next to the station […] and encourage people to squeeze or read the messages"* (P5). Four participants also mentioned that the Kiosk should be monitored in order for people *"not to get crazy squeezing the balls"* (P12) and to analyse peoples' reactions more efficiently.

Two participants suggested the use of the same technology as a Kiosk, but making it more portable and usable for a longer period of time: *"like a website or something that asks you a few questions to determine how green you were this day or week"* (P5). Five participants also mentioned that a poster would not be as effective, as it is not interactive enough and people just ignore the information.

DISCUSSION

A challenge facing society is that many people have trouble linking their current behaviour to long term consequences [26] or that they rapidly become desensitized to the issue [32]. A further challenge is that some people may be less willing than others to take relatively small actions that may be of a personal inconvenience (e.g. turn the TV off overnight, switch off lights in unused rooms) [27]. How can we try to overcome these barriers to behavioural change? Our study has shown that using a playful physical installation that is striking can help to prompt discussion about and reinvigorate engagement with environmental issues.

In particular, as a stand-alone installation, the Green Ball Kiosk was successful at attracting attention, where participation rates remained high throughout the week. Participants felt motivated to interact with the Green Ball Kiosk because it appeared that the novelty of the device

drew them in, followed by discovering that it only required them squeezing one. However, this low level of commitment was enough to provoke reflection on the issues that were represented.

As our survey results revealed, the Green Ball Kiosk was successful at encouraging nearly 50% of participants to have conversations about the environment. As a result of their experience, nearly half also said that they changed their attitudes, while many said that they changed their behaviour, by becoming more environmentally friendly. This finding suggests that this kind of simple playful device, that requires minimal effort, may be able to trigger a big increase in environmental awareness. Part of the effect can also be down to how it encourages the 'honeypot effect', where people take part in groups and a 'social buzz' is created around the installation (cf Gallacher et al. [15]).

Another factor that appeared to make an impact was the way the messages were worded. While our hypothesis, that uncomfortable messages would be more memorable than comfortable messages was not supported, this did not seem to matter. It may have been that the overall positivity of the approach reduced any discomfort the uncomfortable messages elicited [similar to 34]. Either way, our findings not only showed evidence that the installation prompted conversations about environmental behaviours, but that it was also able to positively influence attitudes and behaviour change. In addition, these findings illustrate how playful physical computing approaches [e.g. 17] have the potential to engage people in serious topics through creating opportunities for people to reflect on their habits and how they align with their values [25].

In general, the squeeze data tended to skew towards positive answers (i.e. "sometimes" or "always"). This suggests that many participants were already engaged in pro-environmental behaviours where rather than teaching new knowledge, the Kiosk served as a useful reminder of good behaviour. For those that had become complacent, it reminded them to re-engage with environmentally friendly behaviours, e.g. taking the stairs instead of the lift.

An alternative explanation is that the social context may have influenced responses, where people wanted to appear more environmentally friendly than they might be in practice. However, the fact that some participants 'recalled' messages that were not there suggests that the installation was able to activate existing schemas of related environmental concepts. Therefore, for ideas that are already ingrained into the minds of the general public, then this kind of public kiosk can help to reinforce particular behaviours and to prompt discussions with others.

In sum, we propose that our installation was successful because it looked fun, it was quick to engage with, and it provided physical interaction. Novelty is important, so we recommend that similar installations should be of a short-term nature (e.g. one week only) so that they stand out.

Limitations

One of the main limitations of the study is that our findings our dependent on self-report data. In the case of behaviour change, it would be useful to consider more objective measurements and carrying out pre and post-intervention assessments. It is also possible that participants were more likely to take part if they had a strong interest in the environment. However, using raffle prizes to motivate completion of the questionnaire and interviews, we were able to recruit 3 interviewees who only interacted with the Kiosk once, suggesting that our sample did not only consist of people who were highly engaged.

Another limitation is that none of the participants were motivated enough to scan the QR codes and read further information. It appears that the 'short and sweet' nature of the installation was a double edged sword: participants took part because it was quick and easy, but they soon forgot about the messages and did not think about them very deeply. Added to the fact that a small number of participants considered the humorous tone of the intervention to be at odds with the serious nature of the subject matter, there are questions yet to be answered around the extent to which this approach is likely to resonate with individuals [29] and lead to long term changes.

Further Research

It is vital to develop engaging ways of presenting 'old' information so that it does not feel repetitive to people. Future work needs to include different ways of leveraging social effects to encourage more behaviour change. We are planning to organise a Green Squeezy Environmental Awareness Week where we host a competition between different buildings, and participants can see how those from other departments squeezed. Future work could also explore deploying the installation with a larger, potentially more diverse audience, outside of the university setting.

CONCLUSION

Overall the Green Ball Kiosk was a fun way to remind university staff and students about green issues, to encourage them to take small actions to help the environment and to prompt them to maintain existing habits. We suggest that interactive installations displayed as a temporary exhibit can be effective at drawing people in again to environmental messages in a playful way, and in doing so can generate a 'social buzz' about environmental topics. In sum, as well as serving as a reminder of good practices, it helps people to tap into their existing knowledge, to think about environmental issues in general and encourages the adoption of new behaviours.

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